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First record of the terrestrial predatory leech, *Orobdella kawakatsuorum* Richardson, 1975 (Clitellata, Hirudinea, Erpobdelliformes), from Moneron Island, Sakhalin Oblast, Russia

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Abstract

The terrestrial predatory leech of the genus *Orobdella* Oka, 1895 is recorded for the first time from Moneron Island, which is located southwest of Sakhalin, Russia. Morphological characteristics of the Moneron *Orobdella* clarify its taxonomic identification as *O. kawakatsuorum* Richardson, 1975, which is indigenous to Hokkaido Island in the Japanese Archipelago. The occurrence data extends the northernmost range of the genus *Orobdella* and shows that the leech fauna is shared between Moneron Island and Hokkaido.

Keywords

Far East Asia, leech fauna, new geographical locality, *Orobdella* species distribution

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Introduction

Orobdella Oka, 1895 is a genus of terrestrial predatory leeches endemic to Far East Asia (Sawyer 1986). It currently comprises more than 20 species from the Russian Far East, the Korean Peninsula, the Japanese Archipelago, and Taiwan (Nakano 2017; Nakano and Prozorova 2019). A previous study showed that in the northernmost part of the *Orobdella* distribution three species form a distinct lineage that is sister to the clade composed of the remaining species (Nakano and Prozorova 2019). Two of the three northern species, *Orobdella kawakatsuorum* Richardson, 1975 and *Orobdella koikei* Nakano, 2012, are indigenous mainly to Hokkaido of the Japanese Archipelago, and they show a close sister relationship (Nakano 2012). *Orobdella kawakatsuorum* was also recorded from Rishiri Island and Kunashir Island, which are adjacent to Hokkaido (Nakano 2012; Nakano and Gongalsky 2014) (Fig. 1). *Orobdella ghilarovi* Nakano & Prozorova, 2019 is known from several locations in continental southern Russian Far East (Nakano and Prozorova 2019; Prozorova and Nakano 2020). Additionally, one unidentified species was recorded from the Russian Far East in sympatry with *O. ghilarovi* (Prozorova and Nakano 2020), but its phylogenetic position remains uncertain.

Leeches belonging to the genus *Orobdella* have never been reported from Sakhalin (see Lukin 1976; Kurcheva

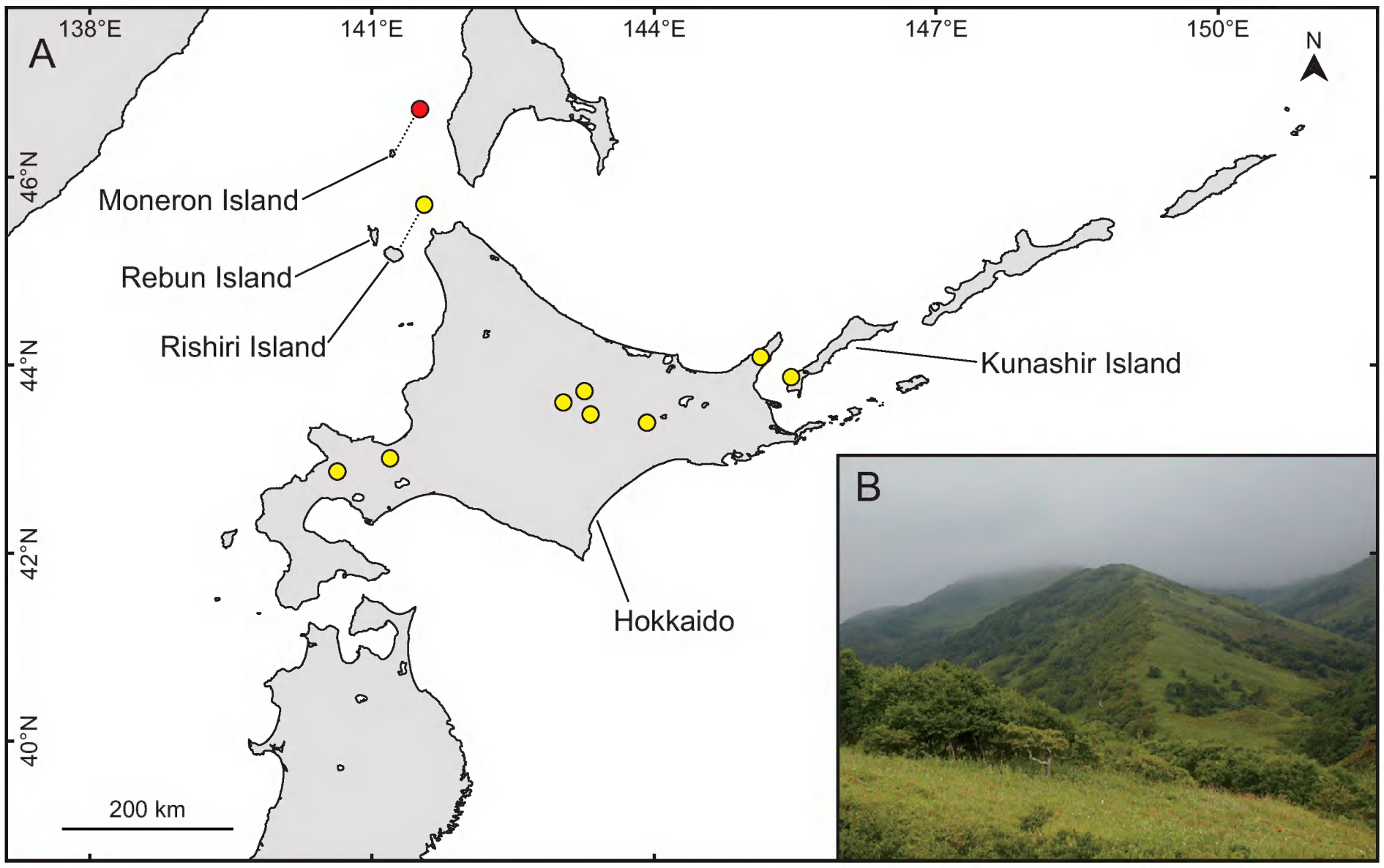

Figure 1. Collection localities and the habitat of *Orobdella kawakatsuorum* Richardson, 1975. **A.** Map showing the collection localities in the preceding studies; the red circle denotes the new locality; the yellow circles are from Richardson (1975), Nakano (2012), and Nakano and Gongalsky (2014); shoreline data were based on Wessel and Smith (1996). **B.** Moneron Island near Chuprov Bay, near the collection locality of *O. kawakatsuorum*; photographed by L. Prozorova.

1977), which is a large island located in the southwestern Sea of Okhotsk. An *Orobdella* specimen was collected from Moneron Island, a small islet located approximately 50 km southwest of Sakhalin. The specimen provides the first occurrence *Orobdella* from Moneron Island. Based on morphological examination, the identity and a brief description of the Moneron *Orobdella* are presented here.

Methods

A leech was collected near a small stream on Moneron Island in 2004 during the expedition of the International Sakhalin Project. The specimen was preserved in 75% ethanol. Examination, dissection, and drawing of the specimen were carried out using a Leica M125C stereoscopic microscope with a drawing tube (Leica Microsystems, Wetzlar, Germany). Four measurements were taken: body length (BL) from the anterior margin of the oral sucker to the posterior margin of the caudal sucker, maximum body width (BW), caudal sucker length (CL) from the anterior to the posterior margin of the sucker, and caudal sucker width (CW) from the right to the left margin of the sucker. The specimen was deposited in the Zoological Collection of Kyoto University (KUZ).

The numbering convention is based on Moore (1927): body somites are denoted by Roman numerals, and the annuli in each somite are given alphanumeric designations.

Results

Genus *Orobdella* Oka, 1895

***Orobdella kawakatsuorum* Richardson, 1975**

Figures 2, 3

New record. Russia – **Sakhalin Oblast** • Moneron Island, near Chuprov Bay; 46°15.83′N, 141°14.50′E; 15.VII. 2004; V.V. Bogatov leg.; 1 specimen, KUZ Z3941.

Identification. Body length 51.6 mm, maximum body width 6.2 mm (Fig. 2). Caudal sucker length 2.2 mm, width 3.3 mm (Fig. 2B). Somites II and III uniannulate, with slight dorsal furrow respectively (Fig. 3A). Somite V biannulate, (a1 + a2) = a3 (Fig. 3A). Somites VI and VII triannulate, a1 = a3 = a3 (Fig. 3A). Somites VIII–XXV quadrannulate, a1 = a2 = b5 = b6 (Fig. 3A, B). Somite XXVI triannulate a1 > a2 < a3; a3 being ventrally

Figure 2. *Orobdella kawakatsuorum* Richardson, 1975, from Moneron Island, KUZ Z3941. **A.** Dorsal view. **B.** Ventral view. Scale bar: 5 mm.

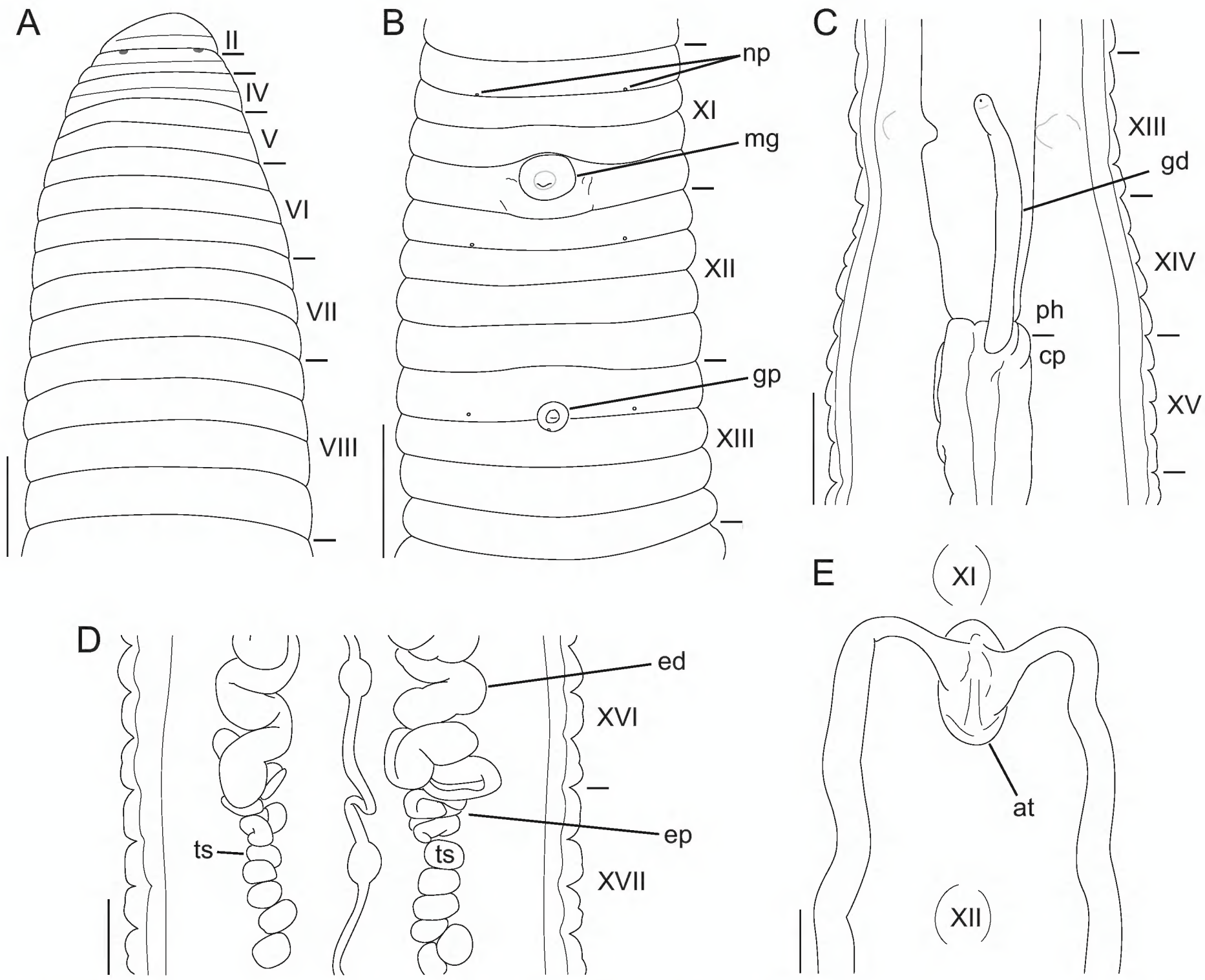

Figure 3. *Orobdella kawakatsuorum* Richardson, 1975, from Moneron Island, KUZ Z3941. **A.** Dorsal view of somites I–VIII. **B.** Ventral view of somites XI–XIII. **C.** Ventral view of gastroporal duct. **D.** Dorsal view of male sperm ducts and testisacs including ventral nervous system. **E.** Dorsal view of male atrium including position of ganglia XI and XII. Abbreviations: at, atrium; cp, crop; ed, ejaculatory duct; ep, epididymis; gd, gastroporal duct; gp, gastropore; mg, male gonopore; np, nephridiopore; ph, pharynx; ts, testisac. Scale bars: A, D = 1 mm; B, C = 2 mm; F = 0.5 mm.

last complete annulus. Somite XXVII uniannulate. Male gonopore in anterior margin of somite XI b6 (Fig. 3B). Female gonopore in somite XIII a1/a2, located posterior to gastropore (Fig. 3B). Gonopores separated by 6 annuli (Fig. 3B). Eyes in 3 pairs 1st pair dorsally on anterior margin of II (Fig. 3A), 2nd and 3rd pairs dorsolaterally on posterior margin of somite V (a1 + a2). Nephridiopores in 17 pairs, each situated ventrally at posterior margin of a1 of each somite in somites VIII–XXIV (Fig. 3B). Pharynx reaching to somite XIV/XV (Fig. 3C). Crop reaching to somite XX/XXI. Intestine reaching to somite XXIV a1. Gastropore ventral, in somite XIII a1/a2 (Fig. 3B). Gastroporal duct simple tubular, reaching to somite XV a1 (Fig. 3C). Testisacs multiple; 1st testisac on respective sides in somite XVII a2 (Fig. 3D), number of sacs on both sides, uncountable. Paired epididymides in somite XVI/XVII to somite XVII a1/a2, occupying 1 annulus (Fig. 3D). Paired ejaculatory ducts in somite XI b5 to somite XVI/XVII (Fig. 3D); coiled in position posterior to ovisacs (Fig. 3D); each duct nearly straight in position anterior to ovisacs; turning proximally towards male atrium in somite XI b5. Atrial cornua undeveloped (Fig. 3E). Atrium in somite XI b5 and b6 (Fig. 3E). Paired ovisacs in somite XIII a1–b5. Right oviduct crossing ventrally beneath nerve cord; both oviducts converging into common oviduct in somite XIII a2.

The Moneron specimen is unequivocally attributed to *O. kawakatsuorum* on the basis of its possession of the following features (see Nakano 2012; Nakano and Gongalsky 2014): male gonopore on anterior margin of somite XI b6, female gonopore in somite XIII a1/a2, 6 annuli between gonopores, simple tubular gonopore, and epididymides in somite XII occupying 1 annulus.

Discussion

The occurrence of *Orobdella kawakatsuorum* from Moneron Island extends the northern distributional limit of the species and the genus. Previously, the most northern population was recorded on Rishiri Island (Nakano 2012), approximately 100 km from Moneron Island (Fig. 1). Thus, the present study provides an additional

example of the faunal relationships between Moneron Island and Rishiri Island.

Moneron Island is located at the northern end of an underwater rise connecting it to the islands of Rishiri and Rebun, close to the coast of Hokkaido. However, even during the maximum oceanic regression of the Late Pleistocene, when the area of Moneron Island increased greatly, it did not connect with Hokkaido, unlike Rishiri and Rebun islands (Razjigaeva and Pletnev 2006). Also, despite its location near Sakhalin, a stable land bridge between Sakhalin and Moneron Island does not appear to have existed in the past, because a trench up to 200 m deep separated these islands. However, the results of the expeditions of the International Sakhalin Project in 2001 and 2004 showed that a predominance of terrestrial invertebrates on Moneron are in common with Sakhalin, the Kuril Islands, Hokkaido and northern Honshu, and that there is an absence of Moneron endemics (Bogatov et al. 2006). This suggests that relatively recent connections occurred between Moneron Island, Sakhalin, and Hokkaido.

Despite the absence of records of terrestrial leeches from Sakhalin (Lukin 1976; Kurcheva 1977), results of the biota survey demonstrate a predominance of East Asian elements on Sakhalin, south of the Schmidt Line separating the Boreal and East Asian biota (Pietsch et al. 2012). This is why, future searches on the island would be worthwhile. Because terrestrial leeches still have not been found on Sakhalin, it is assumed that Moneron Island may be the northernmost distributional limit of the genus *Orobdella*. An additional argument in favor of this assumption is the presence on Moneron Island of exotic Asian pheretimoid earthworms (L. Prozorova personal observation), which are absent on Sakhalin (Ganin 2017) and found north of Japan only on the southern Kuril Islands, i.e., Kunashir, Shikotan, and Yuri islands (Shekhovtsov et al. 2018). Furthermore, molecular genetic data are essential to determine the origin of *O. kawakatsuorum* on Moneron Island, but this information is currently unavailable because of insufficient preservation of the specimen. Further field surveys on Moneron and South Sakhalin are needed to unveil the distribution and phylogeography of the *Orobdella* leeches.

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Authors' Contributions

Conceptualization: LP. Data curation: TN. Funding acquisition: LP, TN. Resources: LP. Visualization: LP, TN. Writing – original draft: LP, TN. Writing – review and editing: LP, TN.

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